REMARKS

Reconsideration and allowance of the subject application are respectfully requested. By this Amendment, Applicant has canceled claim 4. Thus, claims 1-3 and 5-14 are now pending in the application. In response to the Office Action, Applicant respectfully submits that the pending claims define patentable subject matter.

I.   Preliminary Matters

The Examiner objects to the incorporation by reference of Korean Patent Application No. 00-62163 on page 7, lines 15-18 of the present application because the incorporation of essential material in the specification by reference to a foreign application or publication is improper.

By this Amendment, Applicant has amended the specification to replace the reference to Korean Patent Application No. 00-62163 with U.S. Patent Application Publication No. 20020063718 (corresponding to U.S. Application No. 09/885,171 which claims priority from Korean Patent Application No. 00-62163). Applicant submits that this Amendment does not introduce new matter into the present application since U.S. Patent Application Publication No. 20020063718 discloses the same material as Korean Patent Application No. 00-62163.

II.   Claim Rejections under 35 U.S.C. § 112

Claims 1-14 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Further, claims 9, 11 and 12 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

The Examiner asserts that claims 1-14 contain subject matter which is not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Applicant respectfully traverses the enablement rejection.

(A) The Examiner raises enablement questions firstly referring to the specification in page 10, lines 13-20 as described below:

> Next, the similarity is determined based on the continuous relaxation labeling with the compatibility coefficient (step 108). As previously described, in a continuous relaxation labeling process, the initial probability is updated on the basis of compatibility coefficients, and a more recent labeling status. Once the initial probability is assumed, the probability is updated depending on the compatibility coefficients. The compatibility coefficients are used in modeling possible matching conditions to reach a satisfactory labeling.

The Examiner asserts that the specification is not enabling with regard to (1) how the similarity is determined based on the continuous relaxation labeling with the compatibility coefficients is not taught in the specification, (2) how the compatibility coefficients are used in modeling possible matching conditions to reach a satisfactory labeling connected, and (3) how a line "j" is finally labeled with a selected label.

However, the specification discloses, at page 12, lines 6-22, the similarity between the query image and model images is determined by calculating the sum of the node-to-label distances of the query and each of the model images, then the similarity between two images being determined with the reciprocal of the sum and a model image having the highest degree of

similarity being retrieved. Further, at page 8, line 17 through page 10, line 12, the specification discloses how to implement continuous relaxation labeling by obtaining compatibility coefficient $r_{ij}(\lambda, \lambda')$ which is determined to be between 0 and 1 based on the binary relations of the query image and model images. It is also disclosed therein that the compatibility coefficient $r_{ij}(\lambda, \lambda')$ measures the strength of compatibility between node-label pairs, i.e., similarity between nodes of query image and labels of model images.

The specification also discloses how to implement the continuous relaxation labeling in the claimed invention. That is, it is disclosed that a uniform initial probability is assigned to pre-determined number of node-label pairs of query and model image and subsequently said initial probability is updated to reach a satisfactory relaxation labeling, wherein the probability is obtained through defining binary relations between the lines of query and model images, determining compatibility coefficients between node-label pairs of query and model images, and updating the probability using "Zucker's theory" about probabilistic relaxation labeling as disclosed in page 11, lines 5-13.

Regarding how a line "j" is labeled, the Examiner is directed to page 9, lines 6-10 which states that "j" denotes an identifier of a node of the query image rather than a particular line.

(B) The Examiner further asserts that the meaning of equation

$$\rho(i, j, \lambda, \lambda') = (\sum_{k=1}^{K} \left\| \xi_{ij}^{(k)} \zeta_{\lambda\lambda'}^{k} \right\|^{\alpha})^{1/\alpha}$$ on page 10 of the specification is unclear and questions

whether this is a multiplication operation and how this can be a measure of difference in

compatibility between node-label pairs. In addition, the Examiner maintains that the symbols

"α" and "α_i" and "Zucker's theory" are not defined in claims or specification.

Applicant has amended the specification to indicate that the equation should be expressed

as $\rho(i, j, \lambda, \lambda') = (\sum_{k=1}^{K} \left\| \xi_{ij}^{(k)} - \xi_{\lambda\lambda'}^{k} \right\|^{\alpha})^{1/\alpha}$, i.e., the multiplication operation has been replaced with a

subtraction operation. With regard to the symbol α, Applicant submits that it is a well known

factor that weights the labeling of neighboring nodes.[1] Regarding the equation on page 10, it is

disclosed that calculation of the compatibility coefficient $r_{ij}(\lambda, \lambda')$ is implemented by continuous

relaxation labeling. Further, calculation of $(\sum_{k=1}^{K} \left\| \xi_{ij}^{(k)} - \xi_{\lambda\lambda'}^{k} \right\|^{\alpha})^{1/\alpha}$ is explained at page 12, lines 17-

22, where, for one example of binary relations, Euclidian (alternatively, Housdorff) distances

measured between the corresponding nodes of the query images and labels of the model images

are summed up and then the similarity between two images is determined with the reciprocal of

the sum.

"Zucker's theory" is a well-known / conventional updating method expressed as

$p^{(k+1)} = p^k + p^k \beta$. In the present application, i.e., claim 12 and page 11, line 12, β has been

updated as $\dfrac{q_i^{(k)}(\lambda) - \overline{q_i^{(k)}}}{q_i^{(k)}}$.

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[1] Attached are publications entitled "Scene Labeling and Constraint Propagation" and "Relaxation Labeling" respectively, which disclose quantities that may be equivalent to "α" in the present application. For example, Equation 8.24 on page 6 of "Scene Labeling and Constraint Propagation" includes the quantity c_{ij} which is a weighting representing the strength of the interactions between neighboring nodes. Similarly, equations 58 and 59 on page 2 of "Relaxation Labeling" include the quantity ω_{ij} that is also described as a factor that weights the labeling of neighboring nodes.

In view of the above, Applicant respectfully submits that the specification and claims are sufficiently detailed to enable one of ordinary skill in the field of line matching methods to construct the claimed invention and to determine from the claim language the scope of protection encompassed thereby. Accordingly, the Examiner is requested to remove the § 112 rejections.

III.   Prior Art Rejections

Claims 1, 2, 4-7 and 10 are rejected under 35 U.S.C. § 102(b) as being anticipated by Christmas ("Structure Matching in Computer Vision Using Probabilistic Relaxation"). Claim 3 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Christmas in view of Spiegal (USP 5,940,538). Claim 8 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Christmas in view of Yu (USP 5,274,744). Claims 13 and 14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Christmas in view of Imagawa (USP 5,479,570). Applicant respectfully traverses the prior art rejections.

By this Amendment, Applicant has amended independent claim 1 to incorporate the subject matter of dependent claim 4 and rewritten claim 3 in independent form. Thus, claim 1 now requires:

> collecting line information of a query image and model images;
> defining a binary relation between lines of the query image and lines of the model images;
> measuring compatibility coefficients of node-label pairs of the query and model images based on the binary relation; and
> measuring the similarity between the query and model images on the basis of continuous relaxation labeling using the compatibility coefficients, wherein the

> binary relation is invariant with respect to rotations, scale changes and
> translations.

Christmas discloses a probabilistic relaxation theory for matching features extracted from 2D images and how to apply the theory to the problem of matching and recognizing aerial road network images based on road network models and to the problem of edge matching in a stereo pair. In particular, Christmas discloses extracting line segments from a scene and a model image to define a binary relation to measure compatibility coefficients, which in turn are used for measuring the similarity between the scene and model images based on a relaxation updating rule to reach an unambiguous labeling of probability one, wherein binary relations are defined as the relative position of one object with respect to another, relative size, or orientation. See Section II; page 751, 2nd paragraph including Equation (1); last paragraph of Section III in page 753; Section IV, page 753; right column, page 757, 1st-3rd paragraphs after Section VII; Section VII in page 758, equations 44-45; and Section VIII A.

Christmas discloses that:

> [o]f the above binary relations, the angle relation between lines is *invariant* to
> (2D) rotation, translation and scale changes; the distance relation is invariant to
> (2D) rotation and translation but not to scale changes. Therefore our graph
> matching is independent of translation and rotation, but not of scale changes.[2]

Accordingly, Christmas' application of binary relations to graph matching does not teach the use of binary relations that are invariant to scale changes as required by claim 1. Further, Christmas admits in its conclusion (see 1st paragraph in page 763 of Section IX), the results of

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[2] See Christmas at first paragraph of page 758.

matching will deteriorate drastically when scales are changed relative to each other by a factor larger than about 20%.

Accordingly, Applicant respectfully submits that amended claim 1 would not have been anticipated by or rendered obvious in view of Christmas because the cited reference does not teach or suggest all of the features of the claimed invention.

With regard to rejection of claim 3, the Examiner cites Spiegal for allegedly disclosing a method detecting a border of an object via Fig. 12A (elements 1210, 1230 and 1240). However, the teachings of Spiegal are not relevant or related to retrieval of model images from a database indexed by shape descriptors. Further, as the Examiner concedes Christmas does not disclose the subject matter of claim 3.

Accordingly, Applicant respectfully submits that claim 3 should be allowable because the cited references do not teach or suggest all of features of the claimed invention from the cited references.

IV.   Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Patent Application No. 09/884,079

The USPTO is directed and authorized to charge all required fees, except for the Issue

Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any

overpayments to said Deposit Account.

Respectfully submitted,

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